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Restricting daily time at pasture at low and high pasture allowance: Effects on pasture intake and behavioral adaptation of lactating dairy cows

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ABSTRACT

In pasture-based dairy systems, daily time at pasture is restricted during several periods of the year. The aim of this experiment was to evaluate the effect of restricting time at pasture on milk yield, pasture dry matter (DM) intake, and grazing behavior of dairy cows according to pasture allowance (PA), which partly defines pasture availability. The experiment was carried out in spring on strip-grazed perennial ryegrass pastures. The 6 treatments consisted of 3 durations of daily time at pasture [U: unrestricted day and night grazing (22 h at pasture); R9: 1 grazing session restricted to 9 h between the 2 milkings; R5: 2 grazing sessions of 2.75 h after each milking) compared at low and high PA (13 and 24 kg of DM/d per cow >5 cm, respectively). Eighteen mid-lactation Holstein dairy cows were used according to a 6 × 4 incomplete Latin square design replicated 3 times with four 14-d periods. Pasture DM intake was measured by the ytterbium-fecal index method and grazing behavior from portable devices. On average, restricting time at pasture from U to R (mean of R5 + R9) decreased pasture intake by 2.9 kg of DM, milk yield by 1.3 kg, and milk protein concentration by 0.11%, and increased milk fat concentration by 0.20%. Pasture intake and milk yield did not differ significantly between R9 and R5. The reduction of pasture intake and milk yield with decreasing time at pasture was greater at high compared with low PA. Grazing times were 536, 414, and 305 min, representing proportions of time spent grazing of 0.40, 0.77, and 0.93 for treatments U, R9, and R5, respectively. The reduction of grazing time with decreasing time at pasture was greater at high compared with low PA. Pasture intake rate greatly increased with decreasing time at pasture, but mainly on R5 (29.8, 31.6, and 42.1 g of DM/min for U, R9, and R5, respectively). The effect of time at pasture on pasture intake rate was unaffected by PA. In conclusion, the effect of restriction of time at pasture on pasture intake and milk yield becomes more marked as PA increases. Cows offered only 2 grazing sessions of 2.75 h after each milking maximized pasture intake rate and consumed pasture as much as in one 9-h grazing session.

Key words: time at pasture, grazing behavior, pasture intake, dairy cow

INTRODUCTION

In dairy production systems, feeding costs represent a high proportion of total production costs and feeding dairy cows at pasture generally reduces production costs (Dillon et al., 2005). Extending the grazing season is therefore a means of reducing feed costs (Chénais et al., 2001). This, however, implies grazing cows during periods of heavy rainfall, low temperature, and short day length with generally low pasture availability at the farm level requiring forage supplementation. During these periods, the daily time spent at pasture is often restricted, both to limit sward damage during wet conditions and to supplement cows indoors at night. Allowing dairy cows to graze a few hours per day can also improve their welfare compared with cows kept indoors (Dillon et al., 2005; Sairanen et al., 2006), reduce direct fecal and urine deposition to pasture compared with a full-grazing system (Kristensen et al., 2007), or increase grazing efficiency through manipulation of foraging behavior (Chilibroste et al., 2007).

Daily access time at pasture could thus be used as a grazing management tool but its influence on cow performance is not well known. In recent studies, it has been reported that, even with high supplementation levels, milk yield is generally reduced when daily time at pasture is less than 8 h (Mattiauda et al., 2003; Kristensen et al., 2007; Delaby et al., 2008). In 2 recent studies, it has been reported that dairy cows can react to a time constraint at grazing through an increase in the proportion of time spent grazing and in pasture intake rate (Pérez-Ramírez et al., 2008; Kennedy et al., 2009). Grazing conditions such as pasture allowance or

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sward height that partly determine pasture availability and pasture intake rate can potentially affect the adaptability of the cows to a time constraint (Iason et al., 1999; Ginane and Petit, 2005; Chilibroste et al., 2007).

The objective of this study was to test the hypothesis that unsupplemented dairy cows adapt better to a severe restriction of daily access time at pasture at high compared with low pasture allowance because of a greater ability of cows to increase their pasture intake rate at high pasture allowance when time at pasture is restricted.

MATERIALS AND METHODS

Treatments, Experimental Design, and Animals

The 6 treatments consisted of 3 durations of daily time at pasture (22 h, 9 h, or 5.5 h), each compared at low and high pasture allowance (**PA**: 13 vs. 24 kg of DM/d per cow >5 cm). For the unrestricted treatment (**U**), the cows had access day and night to pasture, namely from 0830 to 1630 h and from 1730 to 0730 h. For the restricted 9 h treatment (**R9**), the cows had access to the pasture only between the 2 milkings in one session of 9 h, from 0815 to 1715 h. For the restricted 5.5 h treatment (**R5**), the cows had access to the pasture during 2 sessions per day, from 0745 to 1030 h after the morning milking (2.75 h) and from 1700 to 1945 h after the evening milking (2.75 h). When they were not at pasture or at milking, the cows in treatments R5 and R9 were kept indoors in individual stalls, with free access to water and a salt block. They received neither forage nor concentrate as supplement. Procedures relating to care and use of cows in the current experiment were approved by an animal care committee of the French Ministry of Agriculture, in accordance with French regulations.

The experiment was conducted from April 21 to June 15, 2006, according to an incomplete 6 × 4 Latin square design replicated 3 times, with four 14-d successive periods. The first 8 d of each period were for adaptation to the treatment and the last 6 d for measurements. Eighteen lactating Holstein cows in the second half of lactation were split into 6 groups of 3 cows as similar as possible, each group being assigned a treatment sequence. Cows were grouped according to their lactation number (2.8 ± 1.4), DIM (211 ± 110 d), milk yield at peak of the lactation curve (41.2 ± 7.1 kg), along with milk yield (28.7 ± 6.6 kg), milk fat concentration (3.74 ± 0.60%), milk protein concentration (3.28 ± 0.34%), and BW (626 ± 65 kg), measured 1 wk before the start of the experiment.

Pastures and Grazing Management

This experiment was undertaken at the Institut National de la Recherche Agronomique (INRA) experimental farm of Méjusseaume (1.71°W, 48.11°N; Brittany, France), on 2 paddocks of pure perennial ryegrass (*Lolium perenne* L. cv. 'Ohio') sown 4 yr previously. One paddock was used for periods 1 and 3, and the second for periods 2 and 4. Paddocks 1 and 2 were cut on April 3 and April 17, respectively, to homogenize sward height and to allow, on average, 3 wk of sward regrowth during experimental measurements. During the experiment, paddocks were longitudinally divided into 6 subpaddocks, one per treatment. The relative size of the subpaddocks was proportional to the corresponding PA. At the end of periods 1 and 2, refusals and ungrazed areas were mowed to a cutting height of 5 cm to obtain homogeneous regrowth between treatments during the last 2 periods. Paddocks received 60 kg of N/ha as ammonium nitrate immediately after both cuts.

A strip-grazing system with front and back electric fence was applied throughout the experiment. The area allocated daily to each treatment was adjusted from a daily estimate of the pregrazing pasture mass by multiplying the pregrazing sward height and the sward bulk density (see below). Cows were moved to a new strip once daily after the morning milking. The back fence was moved 1 d after the front fence. Water was always available for each treatment, at pasture and indoors. A salt block was available to cows only indoors and during milking.

Pasture Measurements

Pregrazing pasture mass above 5 cm was measured on d 0, 4, 7, and 11 of each period by cutting 2 strips of 0.5 × 5 m per treatment with a motor scythe. Precut and postcut sward heights were measured on each cut strip with an electronic platemeter (30 × 30 cm, 4.5 kg/m^2, Agro-Systèmes, La Membrolle, France) to calculate the depth of cutting. Sward bulk density was calculated on each strip by dividing herbage mass by the depth of cutting. Pasture DM concentration was determined on each cut strip from a 700-g subsample. The chemical composition of pasture offered was determined on dried subsamples from d 7 and 11, composited per treatment and period. Pasture mass below 5 cm was measured on d 7 and 11 on each strip cut by motor scythe, by cutting the stubble with scissors at ground level in a representative 0.1-m^2 area. Stubble DM concentration was determined after manual removal of soil and roots if any.